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AMERICAN FERTILIZER

" That man is a benefactor to his race who makes two blades of grass to grow where but one grew before."

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The Granulation of Fertilizers by the Rotary Drying Method*

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A PAPER presented before the Fertilizer Division of the American Chemical Society at the Cincinnati meeting on September 9, 1930, was the first of a series on the granulation of fertilizers to call attention to the possibility of granulating fertilizer mixtures by the process of rotary drying (4).† Since that time the different methods for granulating fertilizers (5), the equipment and procedure used in the method of granulation by rotary drying (6) and the factors affecting the granulation of fertilizer mixtures (3) have been discussed in papers from this laboratory.

The different processes that have been proposed or are now in use for the graulation of fertilizers may be classified into the five groups of shredding, compressing, graining, spraying, and rotary drying. Easily fusible materials can be readily granulated by spraying a melt of the material into a cooling tower and a number of fertilizer materials such as urea and sodium nitrate are now being granulated in this way. Most fertilizer materials and mixtures, however, can not be fused without decomposition and the most promising method for granulating a fertilizer of this kind is one that involves a rolling of the moist material in a rotary drum or other device until granules of the desired size are formed and then drying the resulting product, if necessary, in a rotary dryer. This method of granulating is commonly referred to as one of rotary drying.

* A paper presented before the Division of Fertilizer Chemistry at the 98th meeting of the American Chemical Society, Boston, Mass., Sept. 11-15, 1939.

† Numbers in parentheses refer to Literature Cited at the end of the paper.

Factors Affecting Granulation

It was found that the principal factors that affect the granulation of a fertilizer mixture by the method of rotary drying are its moisture content, the temperature of the mixture during granulation, the ratio of organic to inorganic components, the physical properties of its components, and the fineness of its particles before granulation. The moisture content necessary to induce granulation decreases as the temperature increases. It is necessary, as a rule, to dry a fertilizer after it has been granulated and, inasmuch as the effect of an increase in temperature is equivalent to an increase in the moisture content, the preferred procedure would seem to be one in which the mixture is granulated at a temperature at least equal to that at which it is later to be dried and at a moisture content corresponding to the minimum necessary to give the size of granule desired.

An increase in the proportion of an organic ammoniate in a fertilizer mixture increases the moisture required to granulate the mixture and the cost of granulation is thereby also increased. The organic ammoniates in themselves are capable, however, of imparting a satisfactory condition to most fertilizer mixtures when present in any considerable proportion and the granulation of such mixtures is not recommended. A double-strength mixture has only half the bulk of the corresponding single-strength mixture and, other conditions being the same, should cost only half as much to granulate per unit of plant food. Granulation would seem, therefore, to be adapted particularly to the treatment of high-analysis mixtures that are free from or low in

organic components. Such mixtures are usually those most likely to be benefited by a granulating treatment.

Materials such as urea and ammonium nitrate differ from the organic ammoniates in that they tend to decrease rather than increase the moisture required to granulate the mixtures in which they are included. When sufficient urea, for example, is dissolved in a given volume of water to form a saturated solution, a liquid is obtained having about twice the volume of the water used in the preparation of the solution. Any considerable quantity of urea or other highly soluble material in a fertilizer mixture thus increases the solution phase and the plasticity of the mixture by dissolving in the free moisture present. The moisture required to induce granulation is thereby correspondingly reduced.

Granulation takes place when two or more particles stick together with sufficient tenacity to withstand the rolling action to which the resulting larger particles or granules are subjected in their formation. Granulation can only occur, therefore, in such materials and mixtures that exhibit some plastic properties. The plasticity of a material increases with the fineness of the particles and a material in a finely powdered condition therefore granulates more readily than when it is coarsely ground. The presence of a soluble salt facilitates granulation and tends as a rule to increase the hardness of the granule but a soluble salt is not essential to the formation of granules.

Many fertilizers, such as superphosphate and the ordinary types of mixed fertilizers, granulate very readily, and when the best conditions for granulation are maintained, as can easily be done in small scale work, it is possible to obtain a very uniform product of any desired size of granule. Some granular fertilizer materials have already been placed on the market that compare favorably with the best that has been produced on a small scale. In other cases difficulties seem to have been encountered in the production of a uniform, non-caking product.

Theoretically, a fertilizer material such as superphosphate should cake less in a granular than in a powdered form, and caking tests with different superphosphates and mixed fertilizers that had been stored for a period of two years showed that granulation did greatly reduce the caking tendencies of the materials and mixtures used in the tests. It may nevertheless happen that a granulated material, such as superphosphate, may cake more than the powdered material if it contains a higher percentage of moisture or if it is granulated or dried under such conditions as to drive off water of hydration. It is often necessary to dry a granulated material or mixture, but drying it to the point that water of hydration is driven off or the moisture content is reduced below that which is in equilibrium with the atmosphere in which it is stored is not to be recommended as this may induce caking and it adds unnecessarily to the cost of granulation.

Coating Granules

Preliminary work by Hardesty and Adams (2) indicates that the caking of granular fertilizers can be considerably reduced by coating with such materials as magnesium oxide, lime and powdered dolomite. If the coating material is inert, it may be dusted onto the granules during the drying process; if basic, it should not be added to a freshly-made superphosphate immediately after or during granulation as this would interfere with some phases of the curing process such as the conversion of citrate-insoluble P_2O_5 into available forms. Best results have so far been obtained with magnesium oxide. This material is similar to lime in its neutralizing effect and, in addition, it serves as a source of available magnesium. The coating capacity of magnesium oxide would seem to be greater than that of any of the other materials used in the tests, as indicated by the fact that its volume per unit weight is about five times that of powdered dolomite (150 mesh) and nearly twice that of lime. When using either lime or magnesium oxide as coating materials, care should be taken that the quantity added is not sufficient to cause either loss of ammonia or reversion of phosphoric acid.

Discussion of Objections to Granulated Fertilizers

Criticism has been made of granulated fertilizers for the reason that they tend to flow through openings in the distributor when the latter is at rest.

It is difficult to prevent this tendency in some types of equipment which are designed to distribute the ordinary types of fertilizer. Other distributing equipment may be readily adjusted to overcome the difficulty. The advantage of having a drillable, non-segregating fertilizer should more than offset any reasonable cost of such adjustments. As more granulated fertilizers come on the market, the manufacturer of fertilizer distributors will, no doubt, be able to supply the demand for a distributor which will handle either type of fertilizer.

It has also been claimed that the particles in a granulated superphosphate may be so im-

pervious as to reduce the availability of their P_2O_5 content. It is possible to make superphosphate granules that are very hard and the same may sometimes be true of the particles in nongranulated superphosphate. It has been found, however, that the particles in superphosphate that have been properly prepared and granulated are sufficiently porous to affect in no way the availability of the P_2O_5 present.

The cost of the present commercial methods for granulating superphosphate and superphosphate mixtures is a handicap to their general adoption. An increase in the plant food content of a mixture affords a means, as already explained, for reducing the cost of granulation per unit of plant food. The use of high analysis mixtures is increasing but the rate of increase is slow. If the granulating treatment is to be limited to the higher analysis mixtures, its general adoption will also be slow. Results which we have recently obtained in our small scale experiments indicate, however, that it may be possible to so improve the method of granulation that a more uniform product can be obtained while reducing at the same time the cost of the operation.

Commercial Method

One method being used at the present time for the commercial granulation of superphosphate (1) comprises transferring the den superphosphate by means of a crane bucket to a feed hopper and thence by an apron conveyor to a horizontal rotary cylinder which operates at room temperature and atmospheric pressure. Means are provided for spraying water onto the superphosphate while it is being agitated or tumbled in the rotary cylinder. The nodulized superphosphate is discharged into a rotary dryer where it is exposed to a cocurrent flow of hot gases supplied by an oil-fired furnace. Additional means are provided for storing the dried material for several days to a week or more to cure, for milling and screening the cured material, and for returning the fines to the granulating system.

Granulation occurs, as already explained, by small particles sticking together to form larger particles. A uniform product can, therefore, not be obtained unless the material fed into the granulator is also more or less uniform. The present commercial methods of granulation by rotary drying provide means for regulating the moisture content of the superphosphate but no provisions are made for breaking up lumps before it is fed into the granulator nor for controlling the temperature of the material before or during the granulating treatment. Control of granulation by the addition of water during the process offers the disadvantages that it increases the tendency of the material to stick to the walls of the granulating equipment, gives rise to granules of varying size by causing an uneven distribution of moisture in the material being granulated, and adds to the drying costs. It may be further noted that the initial

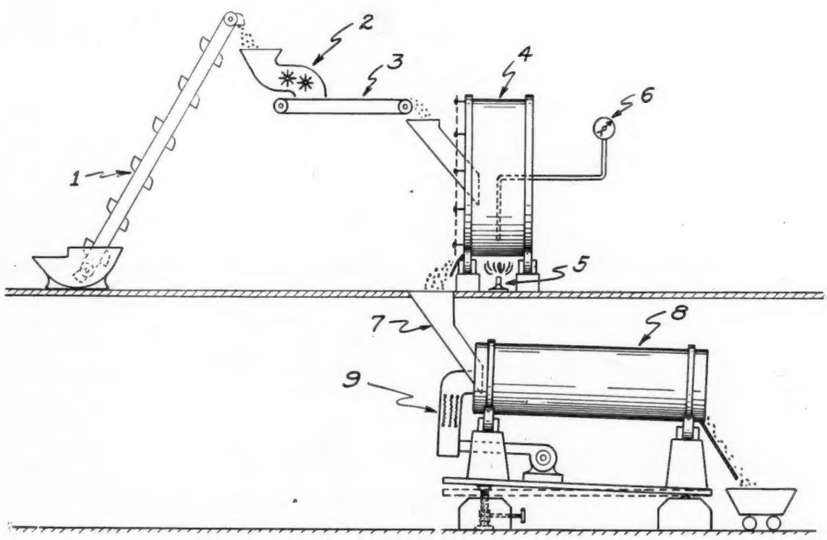

Fig. 1. Equipment for granulating fertilizers.

drying temperature of the product produced by this method is also greater than the temperature at which the material is granulated. Increasing the temperature at this stage of the process has an initial effect similar to that of increasing the moisture content and thereby still further increases the difficulty of producing a uniform granular product.

Improved Method*

Fig. 1 shows a side elevational view of a small scale granulating equipment designed to eliminate some of the difficulties encountered in obtaining a uniform granular product by the method of rotary drying. It comprises an elevator 1 for delivering fresh den superphosphate or other material to be granulated into the disintegrating device 2, a conveyor 3 for transferring it to the granulating drum 4, a gas burner 5 for heating the granulating drum, a dial type thermometer 6 for indicating the temperature of the material in the granulator, a chute 7 for delivering the granulated product from the granulator into the rotary dryer 8, and a means 9 for heating the air that is passed through the drier. The disintegrating device 2, which was designed particularly for breaking up lumps of fresh den superphosphate operates on the principle of the den excavator or the rasping device so commonly used in superphosphate plants. A device of this kind breaks up lumps by a shattering treatment and is much more effective in pulverizing fresh den superphosphate than any form of crushing device.

A granulating drum of commercial size is preferably open at both ends but with the size of granulator used in our tests it was found convenient to close the ends of the drum during the granulating process. One end of the drum is closed permanently, while a means is provided for opening the other end when it is desired to discharge the granulated material into the rotary dryer.

The temperature of the material in the small scale granulator used in our tests can be controlled most conveniently by use of a gas flame applied externally as shown in the figure. On a commercial scale, however, direct heating, as in a rotary drier, would no doubt be the more economical procedure.

The moisture content that is necessary to secure granulation of a material decreases, as already explained, with increase in temperature. It was found that when fresh den superphosphate was heated in the granulator to 60°-100° C. a granular product of surprising uniformity was obtained without the addition of any water whatever. A preliminary heating in the granulator should mean a corresponding saving of heat in the rotary dryer and this step in the process should therefore not add materially to the cost of the operation. Controlling the granulation of fresh den superphosphate by application of heat rather than by the addition of water would, therefore, seem to be the preferable procedure inasmuch as an increase in temperature has less effect in increasing the stickiness of the material than the addition of water, and the cost of driving off the added water in the drying process is thereby eliminated.

The process as represented in Fig. 1 thus differs from that of the afore-mentioned commercial method in that, 1st, the lumps in the material are broken up before it is discharged into the granulator; 2nd, the temperature of the material in the granulator is regulated to give the degree of plasticity required to form the desired size of granules; and 3rd, the product is dried under such conditions that the temperature during the initial stages of the operation does not exceed that at which granulation was effected.

It is advisable to dry a granulated fresh den superphosphate that is intended for shipment without further curing but this step in the process is apparently not necessary if it has been granulated without any addition of water and is to remain in storage for a time. The granular product may then be simply passed through the rotary dryer without further heating to effect cooling and a partial drying of the material. A superphosphate that has been prepared in this way is likely to cake somewhat in storage and to require milling and screening before being placed on the market, but a treatment of this kind will not destroy its granular condition.

Granules of uniform size can be obtained only when the solution phase of the material or mixture to be granulated is uniformly distributed throughout the mass before it enters the granulator. A fresh-den superphosphate meets these requirements. It is possible to granulate a dry cured superphosphate or fertilizer mixture by adding the necessary amount of water during the granulating treatment, but the product obtained is not likely to be as uniform as when the moisture content has reached a state of uniform distribution throughout the material or mixture before it is subjected to granulation.

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* An application has been filed for a patent covering the novel features of this process.

"SULPHATE OF AMMONIA FOR GRASSLANDS"

"Sulphate of Ammonia For Grasslands" is a new 20-page pamphlet just published through the Educational and Research Bureau for By-Product Ammonia, 50 West Broad Street, Columbus, Ohio. This Bureau is sponsored by the U. S. Producers of By-Product Ammonia.

The publication points out that present Government policy is towards more land in grass, and less land in tilled crops; that this means longer rotations and less frequent re-seedings; that inevitably under these conditions clovers and alfalfas tend to run out, and that as these legumes disappear the need for additional nitrogen develops. The work of the Ohio Agricultural Experiment Station, as well as that of other Stations, is drawn on for supporting evidence.

Particularly interesting is the section treating of grass silage. That a high-nitrogen fertilizer, in timely application, can produce enormous crops of green grass high in protein has long been known. Nevertheless, such treatment of grassland did not gain the acceptance which its advantages seemed to merit—for only a fraction of the grass produced could be cut and cured for hay while in optimum condition.

Grass silage, with phosphoric acid or molasses added as a preservative, now offers a feasible way for conserving these heavy crops. The general adoption of the grass silage process does indeed open up a new market for fertilizer use.

The booklet contains instructions for cutting the grass, filling and packing the silo, etc.

TOBACCO ALLOTMENT PROVISIONS CHANGED

A very important change in the provisions for establishing flue-cured tobacco acreage allotments for the years subsequent to 1940 has been announced by the Agricultural Adjustment Administration. The change, which will be effective in 1941 and later years, will permit farmers who desire to do so to grow, in 1940, an acreage that is less than the 1940 acreage allotment without this reduced 1940 planted acreage affecting the size of the future acreage allotments.

In other words, if a producer grows as much as one-half of the 1940 allotment, the allotment for 1940 and later years will be determined as though the full 1940 acreage allotment had been planted. If less than one-half of the 1940 allotment is grown in 1940, the allotment for 1941 and later years will be determined as though one-half of the 1940 allotment had been planted. These provisions are in effect only provided that the farm is not an idle farm, that is, the farm must be in operation in the year 1940. This change recognizes the existing tobacco surplus and prospects for relatively low tobacco prices this year. Under these circumstances many farmers would prefer temporarily to plant an acreage considerably smaller than the 1940 tobacco acreage allotments.

A. C. S. PROGRAM INCLUDES PAPER BY FRAPS

At the coming meeting of the American Chemical Society, in Cincinnati, Ohio, April 8th to12th, Dr. G. S. Fraps, of the Texas Agricultural Experiment Station, will present a paper entitled "Fertilizing Value of Spent Phosphate Catalyst."

A phosphate catalyst is used in the manufacture of petroleum products, and the question arose as to the fertilizing value of the spent catalyst. Solution by the A. O. A. C. method in hydrochloric and nitric acids gave irregular values for total phosphoric acid, about 30 per cent with samples, while ignition with magnesium nitrate (A. O. A. C.) gave 50 per cent. The phosphoric acid was almost completely dissolved by ammonium citrate, showing it to be almost all chemically available. In pot experiments, the phosphoric acid had a high availability to corn and milo as compared with superphosphate.

PALESTINE POTASH PRODUCTION INCREASED

The Palestine Potash, Limited, a company which operates plants at the northern and southern ends of the Dead Sea for the extraction of potash, bromine and other chemicals, continued to expand its production in 1939. Exports of bromine during the first 10 months of 1939 totaled 529 long tons as compared with 324 during the corresponding period of 1938. In the case of potash salts, the tonnage rose to 55,389 from 36,830.

All bromine shipped during 1938 was destined to United Kingdom. Potash salts exported in 1938 were widely distributed. The chief countries in the order of their importance on a value basis were United Kingdom, United States, Japan, Australia, Netherlands, Belgium and Ceylon—American Consulate General, Jerusalem.

Phosphate Rock Industry in 1939

Preliminary Summary

By B. L. JOHNSON, K. G. WARNER and P. M. TYLER
U. S. Bureau of Mines

DOMESTIC demand for phosphate rock improved in 1939 but not quite enough to offset the curtailment in exports caused in part by the blockade of Germany after the outbreak of war in September. Total shipments as reported by American producers to the Bureau of Mines were 3,703,523 long tons valued at $12,167,837, a decrease of 1 per cent in tonnage and 6 per cent in value compared with those in 1938. Mined production rose to 3,985,864 tons in 1939, a 3 per cent gain over the preceding year but still below the 1937 peak of 4,261,416 tons. The output in Tennessee and also in the Western States was greater than in any previous year but that in Florida, by far the leading producing state, was less than it was in 1938 and substantially less than in 1937. Imports were smaller even than usual, only 3,500 tons compared with 7,006 tons in 1938 and 13,400 in 1937. Exports totaled only 949,006 tons compared with 1,140,841 in 1938 and 1,052,802 in 1937. At midyear they were running behind the 1938 figures by 78,357 tons and possible recovery was checked by the virtual elimination of shipments to Germany during the last quarter of the year. Sales of rock to superphosphate plants increased 3 per cent, reflecting an increase in bulk superphosphate output from 3,575,588 short tons in 1938 to 3,801,194 tons in 1939, but stocks of phosphate rock in miners' hands also increased over 1938.

Trade journal quotations for various grades of domestic rock were changed in January, 1939. For Florida land pebble containing 68 per cent B.P.L. there was a slight increase ($1.85 to $1.90) but for higher grades there were substantial decreases. The 70 per cent grade was dropped from $2.35 to $2.15, the 72 per cent grade from $2.85 to $2.40, and the 75 per cent grade from $3.85 to $2.90.

Phosphate rock was mined in Florida, Tennessee, Idaho, and Montana, and apatite in Virginia.

Salient Statistics of the Phosphate Rock Industry in the United States, 1938-39

	1938			1939		
		Value at Mines			Value at Mines	
	Long Tons	Total	Average	Long Tons	Total	Average
Production (mined)	3,860,476	(1)	(1)	3,985,864	(1)	(1)
Sold or used by producers:						
Florida:						
Land pebble[2]	2,528,808	$7,993,665	$3.16	2,496,478	$7,235,055	$2.90
Soft rock	53,479	178,093	3.33	39,666	120,742	3.04
Hard rock	125,048	601,922	4.81	89,096	411,455	4.62
Total, Florida	2,707,335	8,773,680	3.24	2,625,240	7,767,252	2.96
Tennessee[2, 3]	899,298	3,725,601	4.14	938,448	3,856,505	4.11
Idaho	66,014	296,595	4.49	95,451	431,938	4.53
Montana	66,491	155,917	2.34	44,384	112,142	2.53
South Carolina	100	350	3.50	......	......	...
Virginia	(3)	(3)	(3)	(3)	(3)	(3)
Total, United States	3,739,238	12,952,143	3.46	3,703,523	12,167,837	3.29
Imports	7,006	[4]80,539	[4]11.50	3,500	[4]23,625	[4]6.75
Exports	1,140,841	[5]6,637,638	[5]5.82	949,006	[5]5,233,104	[5]5.51
Apparent consumption[6]	2,605,403	(1)	(1)	2,758,017	(1)	(1)
Stocks in producers' hands, Dec. 31:						
Florida	1,285,000	(1)	(1)	1,504,000	(1)	(1)
Tennessee[2, 3]	224,000	(1)	(1)	247,000	(1)	(1)
Other	3,000	(1)	(1)	2,000	(1)	(1)
Total stocks	1,512,000	(1)	(1)	1,753,000	(1)	(1)

[1] Figures not available.
[2] Includes sintered matrix.
[3] Virginia included with Tennessee.
[4] Market value (or price) at port and time of exportation to the United States.
[5] Value at port of exportation.
[6] Quantity sold or used by producers plus imports minus exports.

Florida

Florida's shipments in 1939 were 3 per cent less in quantity than in 1938, and a million dollars less in value. Land pebble, soft rock and hard rock phosphate all shared in the decline. The largest tonnage decrease occurred in land pebble shipments which showed, however, a decline of only 1 per cent in quantity. Greater percentage decreases occurred in both soft and hard rock—26 per cent in the case of soft rock and 29 per cent in hard rock. Some shipments of sintered phosphate rock matrix were made from Pembroke, Florida, to Europe. Total stocks of Florida phosphate rock in hands of producers were higher at the end of 1939 than on December 31, 1938.

Tennessee

The tonnage shipped in 1939 in Tennessee, 938,448 long tons, was 4 per cent greater than in 1938 and consisted almost entirely of brown rock, although a small quantity of blue rock went to T. V. A. Stocks of phosphate rock in hands of the producer at the close of 1939 were larger than at similar periods in 1937 or 1938.

As in previous years six phosphate rock mining companies together with the T.V.A. produced nearly the entire phosphate rock production of Tennessee. All three of the electric-furnace plants—two of which are owned by private interests, the Victor Chemical Co. and the Monsanto Chemical Co., and the T.V.A. plant at Wilson Dam, Alabama, (Muscle Shoals)—were in active operation during 1939, save for a partial shut down at the Monsanto plant for a short time late in the year. The Victor Chemical Co. added two new electric furnaces to its elemental phosphorus plant at Mt. Pleasant, and a nodulizing plant of sufficient capacity for all three of its electric furnaces. Both its electric-furnace plant at Mt. Pleasant and its blast-furnace plant at Nashville, Tennessee, were in operation in 1939.

The Monsanto Chemical Co., the Charleston Mining Co., and the T.V.A. are reported to have increased their holdings of phosphate lands in 1939. A small washing plant, built near Gallatin in Sumner County in 1938, started

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Phosphate Rock Sold or Used by Producers in the United States, 1938-39, by Grades, Uses and Classes of Consumers

	1938 Long Tons	1938 Value	1939 Long Tons	1939 Value
Grades—B.P.L.[1] content (per cent):				
Below 60	450,858	(2)	393,469	(2)
60 to 66	100	(2)	18,818	(2)
68 basis, 66 minimum	378,847	(2)	356,512	(2)
70 minimum	387,501	(2)	383,483	(2)
72 minimum	904,701	(2)	1,176,502	(2)
75 basis, 74 minimum	914,664	(2)	769,360	(2)
75 minimum	......	...	......	...
77 basis, 76 minimum; 77 minimum	327,951	(2)	328,784	(2)
Above 85 (apatite)	(3)	(2)	(3)	(2)
Undistributed[4]	374,616	(2)	276,595	(2)
	3,739,238	$12,952,143	3,703,523	$12,167,837
Uses:				
Superphosphates	2,074,779	(2)	2,141,475	(2)
Phosphates, phosphoric acid and ferrophosphorus	443,086	(2)	479,020	(2)
Direct application to soil	83,069	(2)	94,026	(2)
Fertilizer filler	24,746	(2)	30,527	(2)
Stock and poultry feed	5,904	(2)	1,662	(2)
Undistributed[5]	1,107,654	(2)	956,813	(2)
	3,739,238	$12,952,143	3,703,523	$12,167,837
Classes of Consumers:				
Affiliated companies	959,717	3,182,569	948,640	3,035,268
Other domestic consumers	1,679,615	5,291,308	1,808,493	5,384,961
Exports[6]	1,099,906	4,478,266	946,390	3,747,608
	3,739,238	$12,952,143	3,703,523	$12,167,837

[1] Bone phosphate of lime.
[2] Figures not available.
[3] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[4] Includes grades B.P.L. content between 68 and 70; 69/66; 68/70; 71; 73; 73/74; 76.55; 78; 78/76; and above 85 per cent; also dust, B.P.L. content not known.
[5] Includes exports, some calcined phosphate, as well as phosphatic materials used in pig-iron blast furnaces, concrete aggregates, in the manufacture of concentrated fertilizers, as filler in asphalt mixtures, and as foundry facings.
[6] As reported to the Bureau of Mines by producers (exclusive of exports by dealers, etc.).

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Principal Articles in This Issue

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Prospective Plantings for 1940

March reports from farmers listing the acreage of the principal crops (except cotton) that they intend to grow this year indicate that they are planning some extensive changes in plantings. The most important changes indicated are a shift from corn to soybeans, hay and pasture in the central and eastern Corn Belt to comply with the A.A.A. program; increased, and probably near-record plantings of sorghums in the Southern Plains Area where the drought last fall prevented normal plantings and growth of winter wheat; and increased but not unusually heavy plantings of spring wheat and flaxseed in the northwest, with a particularly large percentage of increase in spring wheat in Washington and Oregon where drought limited seedings of winter wheat last fall. Contemplated changes in plantings of other crops, affecting smaller acreages but of importance to the growers concerned, include increases of 11 per cent in beans, 2 per cent in rice and potatoes, and 1 per cent in oats. Decreases planned include 5 per cent reductions in peanuts and cowpeas, a 2 per cent decrease in sweet potatoes and a more than 21 per cent decrease in tobacco.

These indications of acreage shifts have been adjusted to allow for the usual differences in each state between March plans and final plantings. Ordinarily they indicate about what farmers may be expected to plant with average weather conditions except that publication of the intended acreage sometimes causes them to modify their plans. However, spring plantings depend in part on the acreage of winter wheat

Crop	Planted Acreages			
	Average 1929-38 Thous'ds	1939 Thous'ds	Indicated 1940 Thous'ds	1940 as per cent of 1939
Corn, all	101,758	91,501	87,770	95.9
All spring wheat	22,344	17,532	19,425	110.8
Durum	3,671	3,220	3,539	109.9
Other spring	18,674	14,312	15,886	111.0
Oats	39,501	35,512	35,818	100.9
Barley	12,655	14,546	14,606	100.4
Flaxseed	2,500	2,470	2,836	114.8
Rice	925	1,039	1,057	101.7
Grain sorghums, all	8,380	9,366	10,309	110.1
Potatoes	3,363	3,069	3,130	102.0
Sweet potatoes and yams	860	862	845	98.0
Tobacco	1,674	1,942	1,524	78.5
Beans, dry edible	1,949	1,744	1,935	111.0
Soybeans[1]	4,756	9,023	10,610	117.6
Cowpeas[1]	2,476	2,923	1,767	94.7
Peanuts[1]	1,872	2,410	2,296	95.3
Tame hay[2]	55,808	58,347	59,385	101.8

[1] Grown alone for all purposes. Partly duplicated in hay acreage.
[2] Acreage harvested.

lost and, in some areas, later plantings are dependent on moisture conditions. This year these factors may cause plantings in the Great Plains Area to differ materially from those now planned.

Judging from the plans of farmers as reported this month, the aggregate acreage of all crops (except cotton) planted or grown this year is likely to be not greatly different from the aggregate acreage last year. The small increase in spring planted crops and hay now indicated may be offset by larger losses of winter wheat and rye than farmers allowed for on March 1.

The land planted to feed grains is expected to include a little less than 88 million acres of corn which would be 4 per cent less than the acreage planted last year and the smallest acreage in corn in more than 40 years. Acreage seeded to oats and barley are expected to be about the same as they were last year, March reports indicating prospective increases of less than 1 per cent with moisture conditions none too favorable in the Dakotas. The area in grain sorghums is expected to be increased to more than 10 million acres, an increase of 10 per cent over plantings last year and above plantings in other years except 1935. If wheat abandonment approaches the 15 million acres indicated last fall and adequate rain falls before planting time, a still larger acreage would be probable. Putting these acreages together and allowing for losses of around 7 million acres would indicate a total acreage of feed grains for harvest about equal to the acreage harvested last year.

Reports on potatoes and sweet potatoes show small changes planned. Potato intentions show a 2 per cent increase and those for sweet potatoes a 2 per cent decrease. For each crop the indications are for a planted acreage just under the average during the past four seasons and subsequently below the acreage planted during the depression years.

Another large increase in the acreage of soybeans is in prospect. The area grown alone for all purposes. which did not reach 5 million acres until 1934 seems likely to be between 10 and 11 million acres, nearly 18 per cent above the 9 million acres grown last year. Substantial increases in the acreage to be grown alone are reported from nearly all the important producing states except those in the Cotton Belt where the acreage of soybeans interplanted with corn has been increasing rapidly.

Reports on the acreage of cowpeas and peanuts to be grown alone show large total acreages but decreases of about 5 per cent as compared with last year. In the case of peanuts, increases of 5 per cent are indicated for Virginia and North Carolina, and a 12 per cent decrease is expected in Texas; Georgia and Alabama, where there is usually a large interplanted acreage also, show decreases in the acreage grown alone. Plans regarding interplanted acreages of these crops have not yet been reported.

Reports from tobacco growers indicate that the total acreage is likely to be reduced to 1,524,000 as compared with the unusually large total of 1,942,000 acres last year. Nearly all of the decrease will be in flue-cured tobacco in the coastal states from Virginia south.

FARM INCOME INCREASING

Cash farm income in the first two months of 1940 totaled $1,378,000,000, topping receipts of the same months of last year by $218,000,000. An increase in income from farm marketings accounted for $90,000,000 of the total gain over 1939 while larger Government payments were responsible for the other $128,000,000. The marked increase in Government payments this year has been due largely to the earlier movement of soil conservation payments to farmers. January-February income from marketings of major classes of products, in millions of dollars, were:

	1939	1940
Grains	146	184
Cotton and cottonseed	44	43
Fruits	34	31
Vegetables	72	72
Tobacco	45	59
Meat animals	340	364
Dairy products	214	234
Poultry and eggs	89	91

WAGE RATE FIXED FOR GOVERNMENT FERTILIZER PURCHASES

On March 20th, Secretary of Labor Frances Perkins fixed the minimum wage rate of 30 cents an hour or $12.00 per week of 40 hours for employees of fertilizer companies manufacturing or supplying superphosphate, concentrated superphosphate or mixed fertilizer on government contracts. This ruling applies to the states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Oklahoma and Texas, and affects contracts for which bids are solicited on or after April 19, 1940. Notice has been given to the industry on November 6, 1939 that this action was contemplated but no objections were filed by any member of the industry.

Maryland Fertilizers, 1939

The figures on the tonnage of fertilizers sold in Maryland during 1939, recently issued by L. E. Bopst, Associate State Chemist, show a slight decline from the 1938 statistics. Total sales came to 164,585 tons, a decrease of 1.1 per cent from 1938 sales of 166,407. Both years were well under the 1937 output of 186,285 tons.

Mixed fertilizers accounted for 141,577 tons, with an average analysis of 3.18-10-7.13, as compared with an average of 2.98-8.26-6.19 in 1938. Sales of mixtures containing 20 or more units of plant food amounted to 78,370 tons, while only 827 tons of mixtures with less than 16 units were sold.

Even though the 2-9-5 analysis was not included in the recommended Standard Analyses, this grade again proved the most popular, with sales of 28,170 tons. The 18 Standard Analyses accounted for 65,594 tons.

The total number of analyses registered did not show any material change. Of the 84 mixtures registered, however, 33 had sales of less than 100 tons each, 32 sold from 100 to 1,000 tons each, while only 19 had sales of over 1,000 tons each.

	1939	1938
Firms registered	105	98
Brands registered	921	918
Analyses registered	103	97
Complete fertilizers registered	72	76
Superphosphate and potash mixtures registered	12	11

	1939 Tons	1938 Tons
Total sales	164,585	166,407
Complete fertilizers	126,559	129,679
Superphosphate and potash mixtures	15,018	13,401
Nitrogen salts	901	1,281
Superphosphate	11,633	12,495
Potash salts	1,117	1,140
Nitrogen in mixed fertilizers	4,508	4,265
Phosphoric acid in mixed fertilizers	14,143	11,826
Potash in mixed fertilizers	10,106	8,859

Fifteen Brands Showing Largest Tonnage, 1939

Analysis	Units of Plant Food	1939 Tons	1938 Tons
2-9-5	16	28,170	31,989
2-12-6	20	19,218	14,120
6-6-5	17	14,916	14,519
2-8-10	20	8,955	9,122
3-12-6	21	8,140	6,145
0-10-10	20	6,604	5,431
0-20-0	20	6,018	4,464
0-16-0	16	5,543	7,986
4-8-10	22	5,432	7,161
4-8-8	20	5,231	1,503
0-12-5	17	5,114	6,067
4-8-12	24	4,848	5,496
5-8-12	25	4,343	3,164
4-8-7	19	4,287	9,033
3-8-10	21	3,606	5,215
		130,425	

Tonnage of Maryland Standard Analyses Fertilizer as Recommended for 1939

Analysis	Units of Plant Food	1939 Tons
2-12-6	20	19,218
2-8-10	20	8,955
3-12-6	21	8,140
0-20-0	20	6,018
4-8-8	20	5,231
5-8-12	28	4,343
0-14-6	20	1,738
3-8-15	26	1,673
5-10-5	20	1,647
4-12-4	20	639
0-12-12	24	548
6-8-6	20	475
10-6-4	20	365
4-16-4	24	107
*4-8-12	24	5,509
*2-8-10	20	508
*6-6-8	20	378
*2-12-8	22	102
		65,594

* Special fertilizer analyses for tobacco (potash from sulphate of potash).

FERTILIZER MATERIALS MARKET

NEW YORK

Southern Shipments of Fertilizers Improve. Weather Still Hampers Northern Season. Most Materials in Good Supply. Export Demands Sporadic.

Exclusive Correspondence to "The American Fertilizer."

NEW YORK, March 26, 1940.

With better weather conditions in the south, fertilizer manufacturers are starting to figure on possible additional needs of certain raw materials for later delivery. The continued unseasonable weather in other parts of the country is holding back deliveries of fertilizers.

Sulphate of ammonia continues scarce but stocks of nitrate of soda and muriate of potash are ample and all needs can be promptly supplied.

Supplies of organics are ample, with very little demand by the fertilizer manufacturers for any additional supplies.

Export demand for various fertilizer materials is sporadic, with some shipments being made, but it is expected that this export demand will increase within the next few months.

Nitrate of Soda

Price unchanged and schedule of $27.00 in bulk, $28.30 in 200-lb. bags and $29.00 in 100-lb. bags, port basis, still prevails.

Sulphate of Ammonia

Schedule of $28.00 per ton basis port is still quoted to domestic manufacturers but material is difficult to obtain except by buyers who are under contract. At the moment there seems practically no material available for export.

Castor Pomace

The asking price of $17.50 for domestic material is unchanged, but at certain southern ports foreign castor pomace is available at $2.60 per unit. ($3.16 per unit N).

Nitrogenous Material

Domestic leather meal is available at $2.50 ($3.04 per unit N) delivered ports, and foreign material could probably be purchased for shipment at five to ten cents per unit under this figure.

Potash

The market on this material is unchanged with price firm at 53½ cents per unit K_2O in bulk basis ex vessel.

Superphosphate

This material is still available at $8.50 per ton for run-of-pile for domestic consumption.

Dried Blood

Has weakened and is offered at New York at $2.80 ($3.40½ per unit N), with South American available at $3.05 ($3.70 per unit N) for shipment.

Fish Scrap

The market on Japanese fish meal remains unchanged at $52.00.

BALTIMORE

Cold Weather Delays Fertilizer Shipments. No Demand for Fill-in Material as yet. Sulphate of Ammonia Scarce.

Exclusive Correspondence to "The American Fertilizer."

BALTIMORE, March 26, 1940.

The recent unseasonable cold spell is retarding the spring shipping season which is already late getting under way. In consequence of this, there is practically no demand for raw material, although the markets are generally firm.

Ammoniates.—Ground animal tankage for feeding purposes continues nominal at $4.00 per unit of nitrogen and 10 cents per unit of B.P.L., f.o.b. Baltimore, but buying interest is at a minimum, and the demand for fertilizer purposes is practically nil.

Nitrogenous Material.—Business in this article is dull and at a standstill. The market is nominally $3.00 per unit of nitrogen with orders few and far between.

Sulphate of Ammonia.—The seasonable demand is heavy, with result that some mills are running behind in their deliveries. There is practically no re-sale material to be had, and were it not for the lateness of the season, some of the manufacturers would probably be running short. It is anticipated that there will be a heavy export demand after the present spring shipping season, and this is likely to make itself felt and be reflected in prices for another season.

Nitrate of Soda.—This material has been moving more heavily, as is usual at this time of the year. The market on both the imported and domestic brands continues unchanged at $29.00 per ton of 2,000 lb., in 100-lb. bags, f.o.b. port warehouse.

Fish Meal.—The market continues firm at $58.00 per ton of 2,000 lb., in bags, f.o.b. Baltimore, guaranteed 55 per cent protein, with demand easing up due to the wide difference in price of this class of material as compared with meat meal.

Superphosphate.—Producers are all now busy shipping against contracts previously booked, and the market remains firm and unchanged at $8.50 per ton of 2,000 lb., basis 16 per cent for run-of-pile, and $9.00 for flat 16 per cent grade, both in bulk, f.o.b. Baltimore.

Potash.—Stocks in the hands of manufacturers as well as importers and domestic producers, are ample to take care of the present season's requirements, in consequence of which there has been practically no resale demand.

Bone Meal.—The market on 3 and 50 per cent domestic steamed bone meal ranges from $32.00 to $36.00 per ton, according to mechanical condition, and 4½ and 47 per cent raw bone meal is priced at $30.00 to $32.00 per ton, c.i.f. Baltimore, but with no business passing, as practically all manufacturers covered for their spring requirements sometime ago.

Bags.—The market on burlap during the past two weeks dipped to the lowest point of the year, but has since practically recovered, making the present price of plain, new, 10-oz. bags about $112.00 per thousand, basis 40 cut 54 in., delivered Baltimore.

ATLANTA

Southern Season in Full Swing After Late Start. Increased Tonnage Expected. Material Prices Still Low.

Exclusive Correspondence to "The American Fertilizer."

ATLANTA, March 25, 1940.

After a late spring with one of the coldest winters in recent years, the fertilizer season is now in full swing here in the southeast and shipments should continue well into May, assuming that the tonnage of mixed goods will approximate that of last year.

Based on a preliminary estimate throughout the consuming areas of the south, it would seem that the total tonnage will equal that of last year, if not exceed it by about 10 per cent.

Considering that we have a war in Europe, it is rather singular that the price of fertilizer ingredients has not undergone any substantial advance and quite a number of the various ingredients are now as cheap as they were last summer. This offers a very good opportunity for those buyers who are not fully covered on their requirements to come in the market at this time without having to pay a premium.

Quotations generally are as follows:

Blood.—Imported, $3.25 ($3.95 per unit N), c.i.f.; domestic $3.00 ($3.64½ per unit N), Chicago.

Tankage.—Imported, $3.40 ($4.13½ per unit N) and 10 cents, c.i.f.; domestic, $3.00 ($3.64½ per unit N) and 10 cents Chicago.

Nitrogenous Tankage. — Domestic, $1.85 ($2.25 per unit N), western producing points; imported, $2.50 ($3.04 per unit N), c.i.f.

Nitrate of Soda.—Unchanged; shipments moving in fair volume.

Sulphate of Ammonia.—Spot stocks scarce but no shortage in sight as yet except on export orders, which are hard to fill.

Fish Meal.—Menhaden machined dried scrap, $43.00, f.o.b. southern producing points.

Raw Bone Meal.—4½ and 45 per cent, $31.50, c.i.f.

Steam Bone Meal.—3 and 50 per cent, $29.00, c.i.f.

Cottonseed Meal.—Prime 8 per cent, market firmer, Memphis, $29.00 to $30.00; southeastern mills, $1.50 per ton higher.

CHICAGO

Fertilizer Organics Market Still Quiet. Prices Being Maintained. Feed Market Inactive.

Exclusive Correspondence to "The American Fertilizer."

CHICAGO, March 25, 1940.

No apparent crystallization of the latent interest in the organic market appears manifest at this time, no consequential sales being reported. Sellers are disinclined to materially reduce asking prices, realizing the season will be a late one.

The feed market is quiet, with little trading taking place. Offerings are comparatively light, but most buyers show no buying interest.

Nominal prices are as follows: High grade ground fertilizer tankage, $2.45 to $2.50 ($2.98 to $3.04 per unit N) and 10 cents; standard grades crushed feeding tankage, $2.80 to $2.85 ($3.40½ to $3.46½ per unit N) and 10 cents; blood, $3.00 to $3.10 ($3.64½ to $3.77 per unit N); dry rendered tankage, 67 to 72 cents per unit of protein, Chicago basis.

PHILADELPHIA

Materials Market Quiet. Contract Deliveries Progressing. Prices "Soft" on Some Materials.

Exclusive Correspondence to "The American Fertilizer."

PHILADELPHIA, March 25, 1940.

The fertilizer materials market remains very quiet. Deliveries on contracts are fair, but no interest is being shown in other materials; consequently prices are "soft."

Nitrate of Soda.—Some deliveries are being made on contracts, but the quantities are below normal. Price remains $27.00 in bulk, with usual differential in bags.

Dried Blood.—Offerings at $3.00 ($3.64½ per unit N) arousing no interest.

Tankage.—Price remains about $2.90 ($3.52½ per unit N) and 10 cents, with little interest.

Bone Meal.—3 and 50 per cent quoted at $32.00 to $33.00; 4½ and 45 per cent at $35.00.

Superphosphate.—Deliveries fairly heavy. Price remains firm.

TENNESSEE PHOSPHATE

Cold Wet Weather Delays Spring Farm Work. Phosphate Shipments Increase. Effect of European War Evident.

Exclusive Correspondence to "The American Fertilizer."

COLUMBIA, TENN., March 25, 1940.

After a period of ideal spring weather, this section was rudely awakened two days ago when the thermometer dropped below freezing and a 6 to 11 inch blanket of snow fell before night. The weather this spring has been almost diametrically opposite to that of '39 when, in spite of the cold, the land was firm enough to get into the fields. This year's extreme cold has been accompanied by snow and rain that has

kept farm work backward to a lamentable extent.

The fact that, even with the disadvantageous weather, the shipment of phosphate rock is slightly ahead of the similar period of 1939, indicates a much more widespread interest in phosphate by farmers everywhere.

Shipments of ground rock for direct application continue to increase. In 1938, shipments were made to 15 neighboring states and to Canada. In 1939 the addition of Connecticut, Massachusetts, New York and Texas has increased the number to 19. So far in 1940, orders have also been received from Virginia, North Carolina, Rhode Island and New Jersey in addition to the other states.

The Bureau of Mines figures reflect the same preliminary effect of the present war in Europe on phosphate rock prices, a 10 per cent reduction in exports with a 5 per cent increase in domestic consumption being accompanied by a 5 per cent decrease in price received for total. Florida's total production decreased about 4 per cent, while that in other states increased 4 per cent. As the domestic consumption rapidly increases under war conditions, it is easy to see that if a long war ensues, high prices will follow, as they did in 1917/19, despite reduced export.

Monsanto, Victor and TVA electric furnaces are all in operation and the Victor blast furnace at Nashville is out. It is reported that TVA will soon start its new metaphosphate plant near Godwin, Tenn. Read Phosphate Co., will soon start rebuilding acid plant at Nashville destroyed by fire.

HOCKLEY TO HEAD MARYLAND RACING COMMISSION

Chester F. Hockley, president of The Davison Chemical Corporation, has been appointed chairman of The Maryland Racing Commission by Governor O'Connor to fill the vacancy created by the death of Jervis Spencer, Jr. Mr. Hockley is president of the Maryland Horse Breeders' Association and was recommended for his new appointment by that association, as well as by the Farm Bureau and the State Grange.

FEBRUARY BY-PRODUCT AMMONIA PRODUCTION

Due in part to the shorter month, the production of by-product sulphate of ammonia during February declined to 53,885 tons, a drop of 10.8 per cent from the January output of 60,393 tons, but an increase of almost 30 per cent over February, 1939, figures of 41,780 tons. For the first two months of the present year, 114,278 tons were produced, as compared with 87,537 tons during January and February, 1939.

By-product ammonia liquor was produced to the extent of 2,267 tons (NH_3 content) in February, 1940; 2,404 tons in January, 1940; and 1,787 tons in February, 1939. During the first two months of 1940, production totaled 4,671 tons as compared with 3,753 tons in the same period of the previous year.

EXPORTS OF ARGENTINE ANIMAL BYPRODUCTS

While the United States has always been an important buyer of Argentine fertilizers, bones and dried blood, shipments during 1939 were unusually large. The following official statistics, released by the Ministry of Agriculture, show total Argentina exports for 1938 and 1939, together with the quantities shipped to the United States. Figures are in metric tons.

	Total Export		Exports to U. S.	
Item	1938	1939	1938	1939
Fertilizers	23,008	16,727	6,772	11,547
Bones	51,184	63,574	15,109	37,880
Dried Blood	12,493	12,564	3,706	7,729
Total	86,685	92,865	25,587	57,156

Other important destinations for Argentine shipments during 1939 were Yugoslavia and the United Kingdom for fertilizers, the United Kingdom and Germany for bones, and the Netherlands for dried blood.

An unofficial compilation of export shipping manifests shows a somewhat larger total trade than quantities indicated in the official figures—Office of the American Commercial Attache, Buenos Aires.

PHOSPHATE ROCK INDUSTRY IN 1939

(Continued from page 11)

operations late in 1939. The Federal Chemical Company's plant at Ridley, 1 mile north of Mt. Pleasant, was largely rebuilt during the year.

The T.V.A.'s 3 completed electric furnaces were operated almost continuously throughout the year, according to its annual report. A new electric furnace of different design was nearly completed, and a small experimental electric furnace was operated from time to time. Approximately 69,000 tons of concentrated superphosphate and 4,600 tons of calcium metaphosphate were produced during the fiscal year. All of the Authority's leases on phosphate property were permitted to lapse except two, one in Maury County and one in Sumner County. Options to purchase were taken on 11 tracts and commitments were made to acquire 2 in fee simple and to purchase mineral rights on the other 9. A total of 660 acres of land were involved. During the year purchases were actually consummated on 7 properties in Maury and Giles Counties; interests acquired were fee simple title in one case and mineral rights in the other 6, a total of 968 acres.

Western States

In 1939, as in 1938, Idaho and Montana were the only western states that produced phosphate rock. In Idaho, the Anaconda Copper Mining Company, operated its No. 3 mine at Conda, Caribou County, and the Vassar Produce Co. of Caldwell, Idaho, shipped phosphate rock from Bennington, Bear Lake County. In addition to these two producers, two recently organized companies—the Teton Phosphate Co. of Boise and the Idaho Grange Phosphate Cooperative of Nampa, Idaho—hold phosphate rock deposits in Bear Lake County, Idaho. Neither of these companies reported production in 1939. Montana had two producers—one large and one small. The larger one, the Montana Phosphate Products Co. of Trail, British Columbia, operated the Anderson Mine, near Garrison, Powell County, Montana, and United States Government Leases Great Falls 076740 and 081920, supplying the requirements of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail, British Columbia. The Mineral Hill Mining Co. shipped less than two thousand tons from its mines near Avon, in Powell County, Montana.

Virginia

The Southern Mineral Products Corporation, a subsidiary of the Vanadium Corporation of America, operated its milling plant at Piney River, Va., on apatite-bearing ore from Amherst County, Va.

More detailed figures for the phosphate rock and superphosphate industries of the United States in 1939 are given in the accompanying tables.

Summary of Statistics for Superphosphate Industry in the United States, 1936-39

		1936	1937	1938	1939
Production:[1]					
Bulk superphosphate	short tons	3,412,486	4,429,767	3,575,588	3,801,194
Base and mixed goods	short tons	142,459	122,680	156,730	152,500
Shipments:[1]					
All superphosphate to consumers	short tons	997,011	1,046,334	902,490	897,749
All superphosphate to others	short tons	1,672,049	2,130,860	1,817,293	2,073,123
Base and mixed goods	short tons	1,480,719	1,723,590	1,537,491	1,526,026
Stocks in manufacturers' hands, Dec. 31:[1]					
Bulk superphosphate	short tons	1,133,640	1,313,327	1,361,127	1,233,297
Base and mixed goods	short tons	657,828	784,532	669,503	701,649
Exports of superphosphates[2]	long tons	68,368	78,949	90,237	95,224
Imports of superphosphates[2]	long tons	18,395	57,930	18,753	17,238
Sales of phosphate rock by producers for superphosphate production	long tons	1,768,677	2,391,245	2,074,779	2,141,475

[1] Bureau of the Census, Monthly Statistics Superphosphate Industry, 16 per cent available phosphoric acid.

[2] Bureau of Foreign and Domestic Commerce. Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines.

The Farm Census

The sixteenth census of the United States is under way. It includes a farm and ranch schedule of 232 items upon which the 6,000,000 farmers in the United States will make a report. By it, valuable data relating to farming will be accumulated.

When the founding fathers wrote into the Constitution a provision for the census, they were concerned with making workable the then adolescent theory of democratic Government. They wanted no monarchial decrees administered by noble bureaucrats. They aimed to count the voters and apportion representation. The census was a matter of counting noses, so that each man would be assured of a voice in the laws which govern him.

In the light of the use to which the first census was dedicated, the present census farm schedule is a dramatic document. When we read over its complex breakdown, we see how far not only the first notion of the census has been carried in order to obtain a picture of American agriculture, but we see, too, the complicated new civilization which has spread over the land. Since that first census of 1790, vast domains were added to the Nation. Their acquisition was conceivable to George Washington. But the advances which agriculture, as reflected in the census blank, have made, could never have been foreseen by the Virginia gentleman farmer.

The questions ask for reports on scientific agricultural practices that were unknown in 1790. They ask for estimates on economic status, in terms which were then unknown.

There will be information recorded on the value of the land; the farm mortgage debt; the farm taxes; the days worked off the farm on other jobs; the number of acres irrigated; the amount of business transacted with cooperatives; the number of workers employed, both hired and unpaid members of the family; farm expenditures, which include the amount of commercial fertilizer bought (this is asked to be reported in fractional tons); the amount of liming materials, lime, gypsum, etc., purchased last year.

The results of this survey will be of tremendous value to farmers, agricultural workers, and all industries which have a stake in the farming world. It deserves the full cooperation of all who can contribute to it.

THE GRANULATION OF FERTILIZERS BY THE ROTARY DRYING METHOD

(Continued from page 8)

The following range of particle size is typical of that which may be obtained on a small scale by the proposed method for granulating fresh den superphosphate.

Mesh	Per Cent of Entire Sample
>6	2
6-10	11
10-20	49
20-40	37
<40	1
	100

The superphosphate used in this test was prepared commercially from Florida pebble rock. The material was granulated when less than 18 hours old. Its moisture content at the time it was granulated amounted to 12 per cent and the free acid to 10 per cent. The material from the den was broken up in the disintegrating device to 8 mesh or finer and granulated at a temperature of 94° C.

A granular superphosphate having a range in particle size between 10 and 40 mesh ammoniates more readily than more coarsely

grained material and it represents a less extreme from that with which the farmer is familiar. The size of the granule between reasonable limits seems to have little effect on the drillability of a granulated fertilizer.

The method described for controlling the granulation of fresh den superphosphate by application of heat rather than by the addition of water may also be applied to the granulation of a mixed fertilizer if its moisture content is previously adjusted to the optimum for granulation. The following screen analysis is typical of that obtained in small scale work on high analysis mixtures.

Mesh	Per Cent of Entire Sample
>5	6
5-10	68
10-20	12
20-30	8
<30	6
	100

The particular mixture for which a screen analysis is given had a moisture content of 8 per cent and the temperature at which it was granulated was 63° C. The formula of the mixture is given in Table 1.

Table 1.
Formula of 8-16-16 Mixture

Material	Pounds per Ton
Ammonium sulphate	300
Nitrogen solution II	230
Superphosphate	120
Double superphosphate	660
Potassium nitrate	120
Potassium chloride	460
Calcined kieserite	110

The particle size of the major portion of this 8-16-16 mixture when granulated ranged between 5 and 20 mesh. Smaller sized granules could have been obtained by reducing either the moisture content of the mixture or the temperature of granulation.

The moisture content of the ordinary types of fertilizer mixtures amounts to about 5.0 per cent. Mixtures that contain a relatively high moisture content are likely to cake in storage even when granulated. A partial drying of a fertilizer mixture immediately following granulation is therefore recommended if the moisture required for granulation is much in excess of that normally occurring in the ordinary fertilizer mixture.

Agronomic Results

Comparative field tests with granular and powdered mixtures of identical composition have been made during the past three years in different parts of the country, using such crops as corn, cotton, tobacco and potatoes. The results obtained indicate that, when care is taken to apply granulated and powdered mixtures in the same way, the difference in the physical properties of the mixtures has little or no effect on the growth of the crop. Granulation, however, improves the drillability of fertilizers and prevents losses by dusting when the fertilizer is distributed on a windy day. Granulated fertilizers may therefore be claimed to have an agronomic advantage over powdered mixtures in proportion as they facilitate uniformity of distribution and prevent losses by dusting. Granulation offers the further advantages that it reduces caking, prevents segregation, decreases handling charges, and makes possible a reduction in the use of conditioners.

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BUYERS' GUIDE

A CLASSIFIED INDEX TO ALL THE ADVERTISERS IN "THE AMERICAN FERTILIZER"

This list contains representative concerns in the Commercial Fertilizer Industry, Including fertilizer manufacturers, machinery and equipment manufacturers, dealers in and manufacturers of commercial fertilizer materials and supplies, brokers, chemists, etc.
For Alphabetical List of Advertisers, see page 33.

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

For an Alphabetical List of all the Advertisers, see page 33

BUCKETS—For Hoists, Cranes, etc., Clam Shell, Orange Peel, Drag line, Special; Electrically Operated and Multi Power
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.

BURNERS—Sulphur
Chemical Construction Corp., New York City.

BURNERS—Oil
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.

CABLEWAYS
Hayward Company, The, New York City.

CALCIUM-NITRATE
Synthetic Nitrogen Products Co., New York City.

CAL-NITRO
Synthetic Nitrogen Products Co., New York City.

CARBONATE OF AMMONIA
American Agricultural Chemical Co., New York City.
Du Pont de Nemours & Co., E. I., Wilmington, Del.

CARS—For Moving Materials
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CARTS—Fertilizer, Standard and Roller Bearing
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

CASTINGS—Acid Resisting
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

CASTINGS—Iron and Steel
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CEMENT—Acid-Proof
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

CHAIN DRIVES—Silent
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CHAINS AND SPROCKETS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CHAMBERS—Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

CHEMICAL APPARATUS
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

CHEMICALS
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Company, The, New York City.
Bradley & Baker, New York City.
Du Pont de Nemours & Co., E. I., Wilmington, Del.

CHEMICALS—Continued
Huber & Company, New York City.
Wellmann, William E., Baltimore, Md.

CHEMICAL PLANT CONSTRUCTION
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

CHEMISTS AND ASSAYERS
Gascoyne & Co., Baltimore, Md.
Shuey & Co., Savannah, Ga.
Stillwell & Gladding, New York City.
Wiley & Company, Baltimore, Md.

CLUTCHES
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CONCENTRATORS—Sulphuric Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

CONDITIONERS AND FILLERS
American Limestone Co., Knoxville, Tenn.

CONTACT ACID PLANTS
Chemical Construction Corp., New York City.

COPPER SULPHATE
Tennessee Corporation, Atlanta, Ga.

COTTONSEED PRODUCTS
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

CRANES AND DERRICKS
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corp., Chicago, Ill. and Cedar Rapids, Iowa.
Sackett & Sons Co., The A. J., Baltimore, Md.

CYANAMID
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Jett, Joseph C., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

DENS—Superphosphate
Chemical Construction Corp., New York City.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

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DISINTEGRATORS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DOUBLE SUPERPHOSPHATE (See Superphosphate—Concentrated)

DRYERS—Direct Heat
Sackett & Sons Co., The A. J., Baltimore, Md.

DRIVES—Electric
Link-Belt Company, Philadelphia, Chicago.

DUMP CARS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DUST COLLECTING SYSTEMS
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

ELECTRIC MOTORS AND APPLIANCES
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

ELEVATORS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ELEVATORS AND CONVEYORS—Portable
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

ENGINEERS—Chemical and Industrial
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

ENGINES—Steam
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

EXCAVATORS AND DREDGES—Drag Line and Cableway
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corp., Chicago, Ill. and Cedar Rapids, Iowa.

FERTILIZER MANUFACTURERS
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Farmers Fertilizer Co., Columbus, Ohio.
International Agricultural Corp., New York City.
Smith-Rowland Co., Norfolk, Va.
U. S. Phosphoric Products Corp., New York City.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

FOUNDERS AND MACHINISTS
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Link-Belt Company, Philadelphia, Chicago.

FOUNDERS AND MACHINISTS—Continued
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GARBAGE TANKAGE
Wellmann, William E., Baltimore, Md.

GEARS—Machine Moulded and Cut
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GEARS—Silent
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

GELATINE AND GLUE
American Agricultural Chemical Co., New York City.

GUANO
Baker & Bro., H. J., New York City.

HOISTS—Electric, Floor and Cage Operated, Portable
Hayward Company, The, New York City.

HOPPERS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

IMPORTERS, EXPORTERS
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Wellmann, William E., Baltimore, Md.

IRON SULPHATE
Tennessee Corporation, Atlanta, Ga.

INSECTICIDES
American Agricultural Chemical Co., New York City.

LACING—Belt
Sackett & Sons Co., The A. J., Baltimore, Md.

LIMESTONE
American Agricultural Chemical Co., New York City.
American Limestone Co., Knoxville, Tenn.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Wellmann, William E., Baltimore, Md.

LOADERS—Car and Wagon, for Fertilizers
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

MACHINERY—Coal and Ash Handling
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Elevating and Conveying
Atlanta Utility Works, East Point, Ga.
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

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MACHINERY—Grinding and Pulverizing
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

MACHINERY—Power Transmission
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

MACHINERY—Pumping
Atlanta Utility Works, East Point, Ga.

MACHINERY—Tankage and Fish Scrap
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

MAGNETS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MANGANESE SULPHATE AND CARBONATE
Tennessee Corporation, Atlanta, Ga.

MANGANESE SULPHATE
Tennessee Corportion, Atlanta, Ga.

MIXERS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

NITRATE OF SODA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Company, The, New York City.
Bradley & Baker, New York City.
Chilean Nitrate Sales Corp., New York City.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

NITRATE OVENS AND APPARATUS
Chemical Construction Corp., New York City.

NITROGENOUS ORGANIC MATERIAL
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Smith-Rowland Co., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

NOZZLES—Spray
Monarch Mfg. Works, Inc., Philadelphia, Pa.

PACKING—For Acid Towers
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

PANS AND POTS
Stedman's Foundry and Mach. Works, Aurora, Ind.

PHOSPHATE MINING PLANTS
Chemical Construction Corp., New York City.

PHOSPHATE ROCK
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Charleston Mining Co., Inc., Richmond, Va.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Ruhm, H. D., Mount Pleasant, Tenn.
Schmaltz, Jos. H., Chicago, Ill.
Southern Phosphate Corp., Baltimore, Md.
Taylor, Henry L., Wilmington, Del.
Wellmann, William E., Baltimore, Md.

PIPES—Chemical Stoneware
Chemical Construction Corp., New York City.

PIPES—Wooden
Stedman's Foundry and Mach. Works, Aurora, Ind.

PLANT CONSTRUCTION—Fertilizer and Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Synthetic Nitrogen Products Co., New York City.
Taylor, Henry L., Wilmington, Del.
Wellmann, William E., Baltimore, Md.

POTASH SALTS—Manufacturers and Importers
American Potash and Chem. Corp., New York City.
Potash Co. of America, Baltimore, Md.
United States Potash Co., New York City.

PULLEYS AND HANGERS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

PUMPS—Acid-Resisting
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

PYRITES—Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Jett, Joseph C., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

QUARTZ
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

RINGS—Sulphuric Acid Tower
Chemical Construction Corp., New York City.

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ROUGH AMMONIATES
Bradley & Baker, New York City.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

SCALES—Including Automatic Bagging
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SCRAPERS—Drag
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.

SCREENS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

SEPARATORS—Air
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

SEPARATORS—Including Vibrating
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

SEPARATORS—Magnetic
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHAFTING
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHOVELS—Power
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corp., Chicago, Ill. and Cedar Rapids, Iowa.
Sackett & Sons Co., The A. J., Baltimore, Md.

SPRAYS—Acid Chambers
Monarch Mfg. Works, Inc., Philadelphia, Pa.

SPROCKET WHEELS (See Chains and Sprockets)

STACKS
Sackett & Sons Co., The A. J., Baltimore, Md.

SULPHATE OF AMMONIA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Company, The, New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Hydrocarbon Products Co., New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Snythetic Nitrogen Products Co., New York City.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

SULPHUR
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Texas Gulf Sulphur Co., New York City.

SULPHURIC ACID
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.

SULPHURIC ACID—Continued
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
U. S. Phosphoric Products Corp., New York City.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Taylor, Henry L., Wilmington, N. C.
U. S. Phosphoric Products Corp., New York City.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE—Concentrated
Armour Fertilizer Works, Atlanta, Ga.
International Agricultural Corp., New York City.
U. S. Phosphoric Products Corp., New York City.

SYPHONS—For Acid
Monarch Mfg. Works, Inc., Philadelphia, Pa.

TALLOW AND GREASE
American Agricultural Chemical Co., New York City.

TANKAGE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Smith-Rowland Co., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

TANKAGE—Garbage
Huber & Company, New York City.

TANKS
Sackett & Sons Co., The A. J., Baltimore, Md.

TILE—Acid-Proof
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

TOWERS—Acid and Absorption
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

UNLOADERS—Car and Boat
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

UREA
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Snythetic Nitrogen Products Co., New York City.

UREA-AMMONIA LIQUOR
Du Pont de Nemours & Co., E. I., Wilmington, Del.

VALVES—Acid-Resisting
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

WHEELBARROWS (See Carts)

ZINC SULPHATE
Tennessee Corporation, Atlanta, Ga.

ALPHABETICAL LIST OF ADVERTISERS

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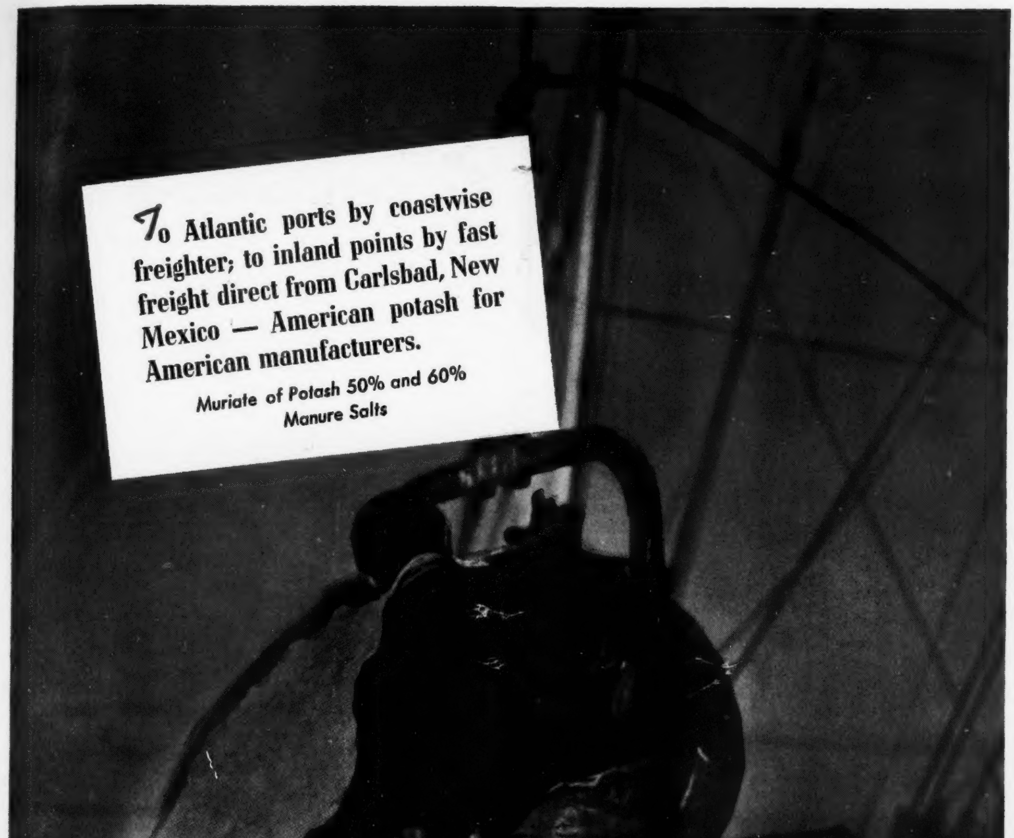
To Atlantic ports by coastwise freighter; to inland points by fast freight direct from Carlsbad, New Mexico — American potash for American manufacturers.
Muriate of Potash 50% and 60%
Manure Salts
P.C.A.
RED MURIATE
POTASH COMPANY
of America
GENERAL SALES OFFICE
MERCANTILE TRUST BUILDING
BALTIMORE, MARYLAND
SOUTHERN SALES OFFICE MORTGAGE GUARANTEE BUILDING ATLANTA GEORGIA